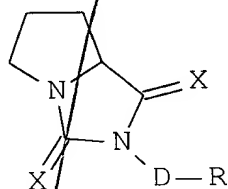


We claim:

1. A compound of the formula:



5 where

each X independently is O, S, or NR<sub>2</sub>;

R<sub>2</sub> is selected from the group consisting of cyano, nitro, hydrogen, C<sub>1</sub>-C<sub>4</sub> alkyl, hydroxy, and C<sub>1</sub>-C<sub>4</sub> alkoxy;

10 D is a direct bond or a C<sub>1</sub>-C<sub>8</sub> alkyl or alkenyl;

R is selected from the group consisting of hydrogen, phenyl, biphenyl, cyclopropyl, cyclobutyl, cyclopentyl, cycloheptyl, cyclooctyl, naphthyl, 1,2,3,4-tetrahydronaphthyl, indenyl, azulenyl, fluorenyl, anthracenyl, isoindolyl, indolinyl, benzofuranyl, benzothiophenyl, indazolyl, benzimidazolyl, tetrahydrofuranyl, tetrahydropyranyl, pyridyl, pyrrolyl, 20 pyrrolidinyl, pyridinyl, pyrimidinyl, purinyl, quinolinyl, isoquinolinyl, tetrahydroquinolinyl, quinolizinyl, furyl, benzofuranyl, thiophenyl, imidazolyl, oxazolyl, benzoxazolyl, benzoxazinyl, 25 thiazolyl, isoxazolyl, isotriazolyl, oxadiazolyl, triazolyl, thiadiazolyl, pyridazinyl, pyrimidinyl, pyrazinyl, triazinyl, trithianyl, indolizinyl, pyrazolyl, pyrazolinyl, pyrazolidinyl, benzopyranyl, thienyl, tetrahydroisoquinolinyl, cinnolinyl, 30 phthalazinyl, quinazolinyl, quinoxalinyl, naphthyridinyl, pteridinyl, carbazolyl,

phenazinyll, phenothiazinyll, phenoxazinyll, and  
adamantyl;

wherein R may be optionally substituted with one  
substituent which is selected from the group  
5 consisting of hydrogen, halo, hydroxyl, nitro,  
trifluoromethyl, C<sub>1</sub>-C<sub>6</sub> straight or branched chain  
alkyl, C<sub>2</sub>-C<sub>6</sub> straight or branched chain alkenyl, C<sub>1</sub>-  
C<sub>4</sub> alkoxy, C<sub>2</sub>-C<sub>4</sub> alkenyloxy, phenyl, phenoxy,  
benzyloxy, and amino;

10 or a pharmaceutically acceptable salt, ester, or solvate  
thereof;

wherein when R is hydrogen, D is a C<sub>5</sub>-C<sub>7</sub> alkyl or C<sub>5</sub>-  
C<sub>8</sub> alkenyl;

wherein when R is phenyl and D is a bond, R must be  
15 substituted with phenyl, hydroxyl, trifluoromethyl, C<sub>2</sub>-C<sub>6</sub>  
straight or branched chain alkyl or alkenyl, C<sub>3</sub>-C<sub>4</sub> alkoxy  
or C<sub>2</sub>-C<sub>4</sub> alkenyloxy, phenoxy, or benzyloxy;

wherein when R is 4-trifluoromethylphenyl, both X  
substituents must be O.

20 2. The compound according to claim 1 that is  
selected from the group consisting of:

(7aS)-2-(1-Naphthyl)perhydropyrrolo[1,2-  
c]imidazole-1,3-dione,

(7aS)-2-(2'-Phenyl)phenylperhydropyrrolo[1,2-  
25 c]imidazole-1,3-dione,

→ (7aS)-2-(4-(Trifluoromethyl)phenyl)perhydropyrrolo  
[1,2-c]imidazole-1,3-dione,

2-benzyl-3-thioxo-2,5,6,7,7a-pentahydro-2-  
azapyrrolizin-1-one,

30 2-hexyl-2,5,6,7,7a-pentahydro-2-azapyrrolizine-1,3-  
dione,

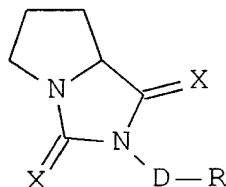
2-(2-ethyl)phenyl-2,5,6,7,7a-pentahydro-2-  
azapyrrolizin-1,3-dione,

2-(3-phenylpropyl)-3-thioxo-2,5,6,7,7a-pentahydro-

2-azapyrrolizin-1-one, and

2-(2-phenylethyl)-3-thioxo-2,5,6,7,7a-pentahydro-2-azapyrrolizin-1-one.

- <sup>342</sup>  
~~C2~~ 3. A pharmaceutical composition comprising an  
5 effective amount of a compound and a pharmaceutically acceptable carrier, wherein the compound is of the formula:



where

- 10 each X independently is O, S, or NR<sub>2</sub>;  
R<sub>2</sub> is selected from the group consisting of cyano, nitro, hydrogen, C<sub>1</sub>-C<sub>4</sub> alkyl, hydroxy, and C<sub>1</sub>-C<sub>4</sub> alkoxy;  
D is a direct bond or C<sub>1</sub>-C<sub>8</sub> alkyl or alkenyl;  
15 R is hydrogen, or an alicyclic or aromatic, mono-, bi- or tricyclic, carbo- or heterocyclic ring;  
wherein R is optionally substituted with one substituent selected from the group consisting of  
20 hydrogen, halo, hydroxyl, nitro, trifluoromethyl, C<sub>1</sub>-C<sub>6</sub> straight or branched chain alkyl, C<sub>2</sub>-C<sub>6</sub> straight or branched chain alkenyl, C<sub>1</sub>-C<sub>4</sub> alkoxy, C<sub>2</sub>-C<sub>4</sub> alkenyloxy, phenyl, phenoxy, benzyloxy, and amino;  
25 or a pharmaceutically acceptable salt, ester, or solvate thereof.

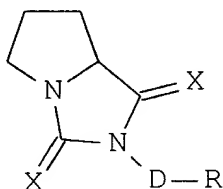
4. The pharmaceutical composition of claim 3, further comprising an additional neurotrophic factor.

5. The pharmaceutical composition of claim 4,  
30 wherein the additional neurotrophic factor is selected from the group consisting of neurotrophic growth factor, brain derived growth factor, glial derived growth

factor, ciliary neurotrophic factor, insulin growth factor and active truncated derivatives thereof, acidic fibroblast growth factor, basic fibroblast growth factor, platelet-derived growth factors, neurotrophin-3, and neurotrophin-4/5.

6. A method of treating a neurological disorder in an animal, comprising:

administering to the animal an effective amount of a compound to stimulate growth of damaged peripheral nerves or to promote neuronal regeneration, wherein the compound is of the formula:



where

each X independently is O, S, or NR<sub>2</sub>;

R<sub>2</sub> is selected from the group consisting of cyano, nitro, hydrogen, C<sub>1</sub>-C<sub>4</sub> alkyl, hydroxy, and C<sub>1</sub>-C<sub>4</sub> alkoxy;

D is a direct bond or C<sub>1</sub>-C<sub>8</sub> alkyl or alkenyl;

R is hydrogen, or an alicyclic or aromatic, mono-, bi- or tricyclic, carbo- or heterocyclic ring;

wherein R is optionally substituted with one substituent selected from the group consisting of hydrogen, halo, hydroxyl, nitro, trifluoromethyl, C<sub>1</sub>-C<sub>6</sub> straight or branched chain alkyl, C<sub>2</sub>-C<sub>6</sub> straight or branched chain alkenyl, C<sub>1</sub>-C<sub>4</sub> alkoxy, C<sub>2</sub>-C<sub>4</sub> alkenyloxy, phenyl, phenoxy, benzyloxy, and amino;

or a pharmaceutically acceptable salt, ester, or solvate thereof.

7. The method of claim 6, wherein the neurological disorder is selected from the group consisting of

peripheral neuropathies caused by physical injury or  
disease state, physical damage to the brain, physical  
damage to the spinal cord, stroke associated with brain  
damage, and neurological disorders relating to  
neurodegeneration.

8. The method of claim 6, wherein the neurological  
disorder is selected from the group consisting of  
Alzheimer's Disease, Parkinson's Disease, amyotrophic  
lateral sclerosis, and Huntington's Disease.

9. The method of claim 6, wherein the neurological  
disorder is Alzheimer's Disease.

10. The method of claim 6, wherein the  
neurological disorder is Parkinson's Disease.

11. The method of claim 6, wherein the  
neurological disorder is amyotrophic lateral sclerosis.

12. The method of claim 6, wherein the  
neurological disorder is Huntington's Disease.

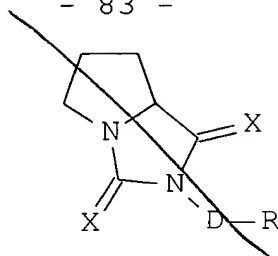
13. The method of claim 6, wherein the compound is  
non-immunosuppressive.

14. The method of claim 6, further comprising  
administering an additional neurotrophic factor.

15. The method of claim 14, wherein the additional  
neurotrophic factor is selected from the group  
consisting of neurotrophic growth factor, brain derived  
growth factor, glial derived growth factor, ciliary  
neurotrophic factor, insulin growth factor and active  
truncated derivatives thereof, acidic fibroblast growth  
factor, basic fibroblast growth factor, platelet-derived  
growth factors, neurotrophin-3, and neurotrophin-4/5.

16. A method of stimulating growth of damaged  
peripheral nerves, comprising:

administering to damaged peripheral nerves an  
effective amount of a compound to stimulate or promote  
growth of the damaged peripheral nerves, wherein the  
compound is of the formula:



where

each X independently is O, S, or NR<sub>2</sub>;

R<sub>2</sub> is selected from the group consisting of cyano, nitro, hydrogen, C<sub>1</sub>-C<sub>4</sub> alkyl, hydroxy, and C<sub>1</sub>-C<sub>4</sub> alkoxy;

D is a direct bond or C<sub>1</sub>-C<sub>8</sub> alkyl or alkenyl;

R is hydrogen, or an alicyclic or aromatic, mono-, bi- or tricyclic, carbo- or heterocyclic ring;

wherein R is optionally substituted with one substituent selected from the group consisting of hydrogen, halo, hydroxyl, nitro, trifluoromethyl, C<sub>1</sub>-C<sub>6</sub> straight or branched chain alkyl, C<sub>2</sub>-C<sub>6</sub> straight or branched chain alkenyl, C<sub>1</sub>-C<sub>4</sub> alkoxy, C<sub>2</sub>-C<sub>4</sub> alkenyloxy, phenyl, phenoxy, benzyloxy, and amino;

or a pharmaceutically acceptable salt, ester, or solvate thereof.

17. The method of claim 16, wherein the compound is non-immunosuppressive.

18. The method of claim 16, further comprising administering an additional neurotrophic factor.

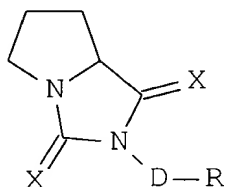
19. The method of claim 18, wherein the additional neurotrophic factor is selected from the group consisting of neurotrophic growth factor, brain derived growth factor, glial derived growth factor, ciliary neurotrophic factor, insulin growth factor and active truncated derivatives thereof, acidic fibroblast growth factor, basic fibroblast growth factor, platelet-derived growth factors, neurotrophin-3, and neurotrophin-4/5.

20. A method for promoting neuronal regeneration

and growth in animals, comprising:

administering to an animal an effective amount of a compound to promote neuronal regeneration, wherein the compound is of the formula:

5



where

each X independently is O, S, or NR<sub>2</sub>;

R<sub>2</sub> is selected from the group consisting of cyano, nitro, hydrogen, C<sub>1</sub>-C<sub>4</sub> alkyl, hydroxy, and C<sub>1</sub>-C<sub>4</sub> alkoxy;

10

D is a direct bond or C<sub>1</sub>-C<sub>8</sub> alkyl or alkenyl;

R is hydrogen, or an alicyclic or aromatic, mono-, bi- or tricyclic, carbo- or heterocyclic ring;

15

wherein R is optionally substituted with one substituent selected from the group consisting of hydrogen, halo, hydroxyl, nitro, trifluoromethyl, C<sub>1</sub>-C<sub>6</sub> straight or branched chain alkyl, C<sub>2</sub>-C<sub>6</sub> straight or branched chain alkenyl, C<sub>1</sub>-C<sub>4</sub> alkoxy, C<sub>2</sub>-C<sub>4</sub> alkenyloxy, phenyl, phenoxy, benzyloxy, and amino;

20

or a pharmaceutically acceptable salt, ester, or solvate thereof.

25

21. The method of claim 20, wherein the compound is non-immunosuppressive.

22. The method of claim 20, further comprising administering an additional neurotrophic factor.

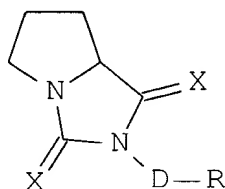
30

23. The method of claim 22, wherein the additional neurotrophic factor is selected from the group consisting of neurotrophic growth factor, brain derived growth factor, glial derived growth factor, ciliary neurotrophic factor, insulin growth factor and active

truncated derivatives thereof, acidic fibroblast growth factor, basic fibroblast growth factor, platelet-derived growth factors, neurotrophin-3, and neurotrophin-4/5.

24. A method for preventing neurodegeneration in an animal, comprising:

administering to an animal an effective amount of a compound to prevent neurodegeneration, wherein the compound is of the formula:



where

each X independently is O, S, or NR<sub>2</sub>;

R<sub>2</sub> is selected from the group consisting of cyano, nitro, hydrogen, C<sub>1</sub>-C<sub>4</sub> alkyl, hydroxy, and C<sub>1</sub>-C<sub>4</sub> alkoxy;

D is a direct bond or C<sub>1</sub>-C<sub>3</sub> alkyl or alkenyl;

R is hydrogen, or an alicyclic or aromatic, mono-, bi- or tricyclic, carbo- or heterocyclic ring;

wherein R is optionally substituted with one substituent selected from the group consisting of hydrogen, halo, hydroxyl, nitro, trifluoromethyl, C<sub>1</sub>-C<sub>6</sub> straight or branched chain alkyl, C<sub>2</sub>-C<sub>6</sub> straight or branched chain alkenyl, C<sub>1</sub>-C<sub>4</sub> alkoxy, C<sub>2</sub>-C<sub>4</sub> alkenyloxy, phenyl, phenoxy, benzyloxy, and amino;

or a pharmaceutically acceptable salt, ester, or solvate thereof.

25. The method of claim 24, wherein the neurodegeneration is Alzheimer's Disease.

26. The method of claim 24, wherein the neurodegeneration is Parkinson's Disease.

27. The method of claim 24, wherein the



neurodegeneration is amyotrophic lateral sclerosis.

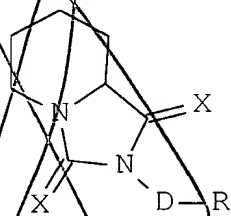
28. The method of claim 24, wherein the neurodegeneration is Huntington's Disease.

29. The method of claim 24, wherein the compound is non-immunosuppressive.

30. The method of claim 24, further comprising administering an additional neurotrophic factor.

31. The method of claim 30, wherein the additional neurotrophic factor is selected from the group consisting of neurotrophic growth factor, brain derived growth factor, glial derived growth factor, ciliary neurotrophic factor, insulin growth factor and active truncated derivatives thereof, acidic fibroblast growth factor, basic fibroblast growth factor, platelet-derived growth factors, neurotrophin-3, and neurotrophin-4/5.

32. A compound of the formula:



where

each X independently is O, S, or NR<sub>2</sub>;

R<sub>2</sub> is selected from the group consisting of cyano, nitro, hydrogen, C<sub>1</sub>-C<sub>4</sub> alkyl, hydroxy, and C<sub>1</sub>-C<sub>4</sub> alkoxy;

D is a direct bond or a C<sub>1</sub>-C<sub>8</sub> alkyl or alkenyl;

R is selected from the group consisting of hydrogen, phenyl, biphenyl, cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, cycloheptyl, cyclooctyl, 1,2,3,4-tetrahydronaphthyl, indenyl, azulenyl, fluorenyl, anthracenyl, indolyl, isoindolyl, indolinyl, benzofuranyl, benzothiophenyl, indazolyl, benzimidazolyl, tetrahydrofuranyl,

tetrahydropyranyl, pyridyl, pyrrolyl,  
pyrrolidinyl, pyridinyl, pyrimidinyl, purinyl,  
quinolinyl, isoquinolinyl,  
5 tetrahydroquinolinyl, quinolizinyl, furyl,  
thiophenyl, imidazolyl, oxazolyl,  
benzopyranyl, thiazolyl, isotriazolyl,  
oxadiazolyl, triazolyl, thiadiazolyl,  
pyridazinyl, pyrimidinyl, pyrazinyl,  
10 triazinyl, trithianyl, indolizinyl, pyrazolyl,  
pyrazolinyl, pyrazolidinyl, thienyl,  
tetrahydroisoquinolinyl, cinnolinyl,  
phthalazinyl, quinazolinyl, naphthyridinyl,  
pteridinyl, carbazolyl, acridinyl, phenazinyl,  
phenothiazinyl, phenoxazinyl, and adamantyl;

15 wherein R may be optionally substituted with one  
substituent which is selected from the group  
consisting of hydrogen, halo, hydroxyl, nitro,  
trifluoromethyl, C<sub>1</sub>-C<sub>6</sub> straight or branched chain  
alkyl, C<sub>2</sub>-C<sub>6</sub> straight or branched chain alkenyl, C<sub>1</sub>-  
20 C<sub>4</sub> alkoxy, C<sub>2</sub>-C<sub>4</sub> alkenyloxy, phenyl, phenoxy,  
benzyloxy, and amino;

or a pharmaceutically acceptable salt, ester, or solvate  
thereof;

25 wherein when R is hydrogen, D is a C<sub>5</sub>-C<sub>8</sub> alkyl or  
alkenyl;

wherein when R is phenyl and D is a bond, R must be  
substituted with C<sub>2</sub>-C<sub>3</sub> or C<sub>5</sub>-C<sub>6</sub> straight or branched chain  
alkyl or alkenyl, C<sub>3</sub>-C<sub>4</sub> alkoxy or C<sub>2</sub>-C<sub>4</sub> alkenyloxy,  
phenyl, phenoxy, benzyloxy, or amino.

30 33. The compound according to claim 32 that is  
selected from the group consisting of:

2-Benzyl-2,5,6,7,8,8a-hexahydro-2-aza-indolizine-  
1,3-dione,

2-benzyl-3-thioxo-2,5,6,7,8,8a-hexahydro-2-  
35 aza-indolizin-1-one,

2-(2-phenylethyl)-3-thioxo-2,5,6,7,8,8a-hexahydro-  
2-azaindolizine-1-one,

2-Heptyl-2,5,6,7,8,8a-hexahydro-2-azaindolizine-  
1,3-dione,

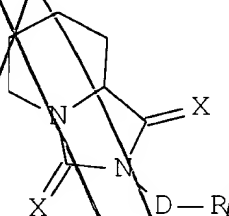
5 2-Octyl-2,5,6,7,8,8a-hexahydro-2-azaindolizine-1,3-  
dione,

2-(3-phenylpropyl)-3-thioxo-2,5,6,7,8,8a-hexahydro-  
2-azaindolizine-1-one,

10 2-hexyl-2,5,6,7,8,8a-hexahydro-2-azaindolizine-1,3-  
dione, and

2-Cyclohexyl-2,5,6,7,8,8a-hexahydro-2-  
azaindolizine-1,3-dione.

15 34. A pharmaceutical composition comprising an  
effective amount of a compound and a pharmaceutically  
acceptable carrier, wherein the compound is of the  
formula:



where

each X independently is O, S, or NR<sub>2</sub>;

20 R<sub>2</sub> is selected from the group consisting of  
cyano, nitro, hydrogen, C<sub>1</sub>-C<sub>4</sub> alkyl, hydroxy,  
and C<sub>1</sub>-C<sub>4</sub> alkoxy;

D is a direct bond or C<sub>1</sub>-C<sub>8</sub> alkyl or alkenyl;

25 R is hydrogen, or an alicyclic or aromatic,  
mono-, bi- or tricyclic, carbo- or  
heterocyclic ring;

wherein R is optionally substituted with one  
substituent selected from the group consisting of  
hydrogen, halo, hydroxyl, nitro, trifluoromethyl,  
30 C<sub>1</sub>-C<sub>6</sub> straight or branched chain alkyl, C<sub>2</sub>-C<sub>6</sub>  
straight or branched chain alkenyl, C<sub>1</sub>-C<sub>4</sub> alkoxy, C<sub>2</sub>-

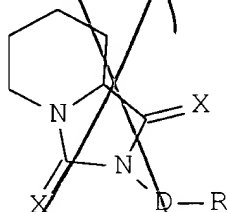
C<sub>4</sub> alkenyloxy, phenyl, phenoxy, benzyloxy, and amino;  
or a pharmaceutically acceptable salt, ester, or solvate thereof.

5        35. The pharmaceutical composition of claim 34, further comprising an additional neurotrophic factor.

36. The pharmaceutical composition of claim 35, wherein the additional neurotrophic factor is selected from the group consisting of neurotrophic growth factor, brain derived growth factor, glial derived growth factor, ciliary neurotrophic factor, insulin growth factor and active truncated derivatives thereof, acidic fibroblast growth factor, basic fibroblast growth factor, platelet-derived growth factors, neurotrophin-3, and neurotrophin-4/5.

37. A method of treating a neurological disorder in an animal, comprising:

administering to the animal an effective amount of a compound to stimulate growth of damaged peripheral nerves or to promote neuronal regeneration, wherein the compound is of the formula:



where

each X independently is O, S, or NR<sub>2</sub>;  
25        R<sub>2</sub> is selected from the group consisting of cyano, nitro, hydrogen, C<sub>1</sub>-C<sub>4</sub> alkyl, hydroxy, and C<sub>1</sub>-C<sub>4</sub> alkoxy;  
D is a direct bond or C<sub>1</sub>-C<sub>8</sub> alkyl or alkenyl;  
R is hydrogen, or an alicyclic or aromatic, mono-, bi- or tricyclic, carbo- or  
30        heterocyclic ring;

wherein R is optionally substituted with one  
substituent selected from the group consisting of  
hydrogen, halo, hydroxyl, nitro, trifluoromethyl,  
C<sub>1</sub>-C<sub>6</sub> straight or branched chain alkyl, C<sub>2</sub>-C<sub>6</sub>  
5 straight or branched chain alkenyl, C<sub>1</sub>-C<sub>4</sub> alkoxy, C<sub>2</sub>-  
C<sub>4</sub> alkenyloxy, phenyl, phenoxy, benzyloxy, and  
amino;

or a pharmaceutically acceptable salt, ester, or solvate  
thereof.

10 38. The method of claim 37, wherein the  
neurological disorder is selected from the group  
consisting of peripheral neuropathies caused by physical  
injury or disease state, physical damage to the brain,  
physical damage to the spinal cord, stroke associated  
15 with brain damage, and neurological disorders relating  
to neurodegeneration.

39. The method of claim 37, wherein the  
neurological disorder is selected from the group  
consisting of Alzheimer's Disease, Parkinson's Disease,  
20 amyotrophic lateral sclerosis, and Huntington's Disease.

40. The method of claim 37, wherein the  
neurological disorder is Alzheimer's Disease.

41. The method of claim 37, wherein the  
neurological disorder is Parkinson's Disease.

25 42. The method of claim 37, wherein the  
neurological disorder is amyotrophic lateral sclerosis.

43. The method of claim 37, wherein the  
neurological disorder is Huntington's Disease.

30 44. The method of claim 37, wherein the compound  
is non-immunosuppressive.

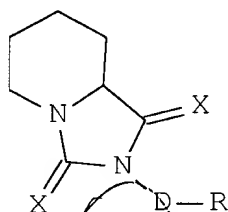
45. The method of claim 37, further comprising  
administering an additional neurotrophic factor.

35 46. The method of claim 45, wherein the additional  
neurotrophic factor is selected from the group  
consisting of neurotrophic growth factor, brain derived

growth factor, glial derived growth factor, cilia neurotrophic factor, insulin growth factor and active truncated derivatives thereof, acidic fibroblast growth factor, basic fibroblast growth factor, platelet-derived growth factors, neurotrophin-3, and neurotrophin-4/5.

47. A method of stimulating growth of damaged peripheral nerves, comprising:

administering to damaged peripheral nerves an effective amount of a compound to stimulate or promote growth of the damaged peripheral nerves, wherein the compound is of the formula:



where

each X independently is O, S, or NR<sub>2</sub>;

R<sub>2</sub> is selected from the group consisting of cyano, nitro, hydrogen, C<sub>1</sub>-C<sub>4</sub> alkyl, hydroxy, and C<sub>1</sub>-C<sub>4</sub> alkoxy;

D is a direct bond or C<sub>1</sub>-C<sub>8</sub> alkyl or alkenyl;

R is hydrogen, or an alicyclic or aromatic, mono-, bi- or tricyclic, carbo- or heterocyclic ring;

wherein R is optionally substituted with one substituent selected from the group consisting of hydrogen, halo, hydroxyl, nitro, trifluoromethyl, C<sub>1</sub>-C<sub>6</sub> straight or branched chain alkyl, C<sub>2</sub>-C<sub>6</sub> straight or branched chain alkenyl, C<sub>1</sub>-C<sub>4</sub> alkoxy, C<sub>2</sub>-C<sub>4</sub> alkenyloxy, phenyl, phenoxy, benzyloxy, and amino;

or a pharmaceutically acceptable salt, ester, or solvate thereof.

48. The method of claim 47, wherein the compound

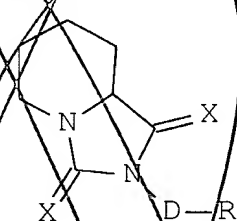
is non-immunosuppressive.

49. The method of claim 47, further comprising administering an additional neurotrophic factor.

50. The method of claim 49, wherein the additional neurotrophic factor is selected from the group consisting of neurotrophic growth factor, brain derived growth factor, glial derived growth factor, ciliary neurotrophic factor, insulin growth factor and active truncated derivatives thereof, acidic fibroblast growth factor, basic fibroblast growth factor, platelet-derived growth factors, neurotrophin-3, and neurotrophin-4/5.

51. A method for promoting neuronal regeneration and growth in animals, comprising:

administering to an animal an effective amount of a compound to promote neuronal regeneration, wherein the compound is of the formula:



where

- each X independently is O, S, or  $\text{NR}_2$ ;
- 20  $\text{R}_2$  is selected from the group consisting of cyano, nitro, hydrogen,  $\text{C}_1\text{-C}_4$  alkyl, hydroxy, and  $\text{C}_1\text{-C}_4$  alkoxy;
- D is a direct bond or  $\text{C}_1\text{-C}_8$  alkyl or alkenyl;
- R is hydrogen, or an alicyclic or aromatic, mono-, bi- or tricyclic, carbo- or
- 25 heterocyclic ring;
- wherein R is optionally substituted with one substituent selected from the group consisting of hydrogen, halo, hydroxyl, nitro, trifluoromethyl,  $\text{C}_1\text{-C}_6$  straight or branched chain alkyl,  $\text{C}_2\text{-C}_6$
- 30 straight or branched chain alkenyl,  $\text{C}_1\text{-C}_4$  alkoxy,  $\text{C}_2\text{-}$

C<sub>4</sub> alkenyloxy, phenyl, phenoxy, benzyloxy, and amino;

or a pharmaceutically acceptable salt, ester, or solvate thereof.

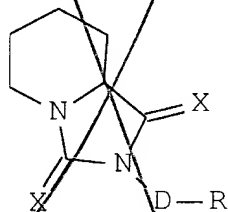
5        52. The method of claim 51, wherein the compound is non-immunosuppressive.

53. The method of claim 51, further comprising administering an additional neurotrophic factor.

10        54. The method of claim 53, wherein the additional neurotrophic factor is selected from the group consisting of neurotrophic growth factor, brain derived growth factor, glial derived growth factor, ciliary neurotrophic factor, insulin growth factor and active truncated derivatives thereof, acidic fibroblast growth factor, basic fibroblast growth factor, platelet-derived growth factors, neurotrophin-3, and neurotrophin-4/5.

15        55. A method for preventing neurodegeneration in an animal, comprising:

20        administering to an animal an effective amount of a compound to prevent neurodegeneration, wherein the compound is of the formula:



where

25        each X independently is O, S, or NR<sub>2</sub>;  
R<sub>2</sub> is selected from the group consisting of cyano, nitro, hydrogen, C<sub>1</sub>-C<sub>4</sub> alkyl, hydroxy, and C<sub>1</sub>-C<sub>4</sub> alkoxy;  
D is a direct bond or C<sub>1</sub>-C<sub>8</sub> alkyl or alkenyl;  
R is hydrogen, or an alicyclic or aromatic, mono-, bi- or tricyclic, carbo- or  
30        heterocyclic ring;



wherein R is optionally substituted with one  
substituent selected from the group consisting of  
hydrogen, halo, hydroxyl, nitro, trifluoromethyl,  
C<sub>1</sub>-C<sub>6</sub> straight or branched chain alkyl, C<sub>2</sub>-C<sub>6</sub>  
5 straight or branched chain alkenyl, C<sub>1</sub>-C<sub>4</sub> alkoxy, C<sub>2</sub>-  
C<sub>4</sub> alkenyloxy, phenyl, phenoxy, benzyloxy, and  
amino;

or a pharmaceutically acceptable salt, ester, or solvate  
thereof.

10 56. The method of claim 55, wherein the  
neurodegeneration is Alzheimer's Disease.

57. The method of claim 55, wherein the  
neurodegeneration is Parkinson's Disease.

15 58. The method of claim 55, wherein the  
neurodegeneration is amyotrophic lateral sclerosis.

59. The method of claim 55, wherein the  
neurodegeneration is Huntington's Disease.

60. The method of claim 55, wherein the compound  
is non-immunosuppressive.

20 61. The method of claim 55, further comprising  
administering an additional neurotrophic factor.

25 62. The method of claim 61, wherein the additional  
neurotrophic factor is selected from the group  
consisting of neurotrophic growth factor, brain derived  
growth factor, glial derived growth factor, ciliary  
neurotrophic factor, insulin growth factor and active  
truncated derivatives thereof, acidic fibroblast growth  
factor, basic fibroblast growth factor, platelet-derived  
growth factors, neurotrophin-3, and neurotrophin-4/5.

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